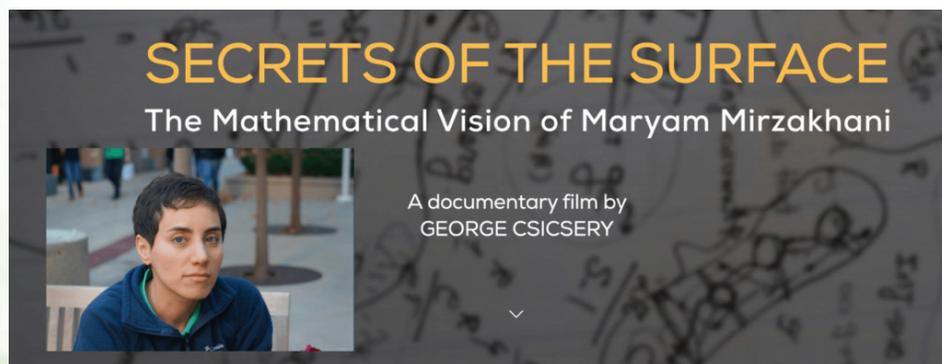


Review of the Film *Secrets of the Surface* by George Csicsery, 2020

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If you are a young girl who enjoys mathematics, what are the chances that you will choose to study this subject beyond school, beyond college? What are the chances that you will end up as a woman mathematician? Sadly, very low. There may be a few different reasons for this, one of which is also true for boys: most young people are advised to choose subjects based on career paths, not on whether the subject excites and enthralls them! But there is another very unfortunate reason: many of us, including girls and women, believe that female brains are less capable of learning mathematics than male brains! This deep-seated stereotype is widespread in the world, and we call it a stereotype because there is simply no convincing evidence that the female brain is inherently less capable of some kinds of learning and thinking. On the contrary, plenty of research with babies shows that girls and boys are indistinguishable in their cognitive capacities. But the problematic data is that at various levels of education, girls perform less well than boys on high-stakes math tests, and of course there are the enrolment numbers that tell the story of the 'leaky pipeline': as you go higher and higher in mathematics degrees, you find fewer and fewer women. Studies suggest that the main reason for females dropping out along the way is that most of



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us have this picture that *math is for men*. It seems that socialisation is the source of the problem, not innate ability.

Several articles and books have been written on this topic, and a few resources are listed at the end of this piece. It is very important for us teachers of mathematics to realise that we may implicitly have this belief ourselves, and to watch for signs of it guiding our actions. We should also think of ways to offer counter evidence for the stereotype, and this is why the film *Secrets of the Surface* is a good one to share with your students.

When you and your students watch *Secrets of the Surface*, the 2020 documentary film by George Csicsery about the renowned Iranian mathematician Maryam Mirzakhani, who lived from 1977-2017, you will be lifted off into another world: a world of culture, mathematics, and excitement around discoveries in geometry. The film traces her story of growing up in Tehran, going to school, developing an interest in math, shooting to fame and recognition, journeying to the USA, working at Harvard, Princeton and Stanford Universities, culminating in her being the first woman ever to win the prestigious Fields medal for mathematics. She died tragically from cancer at the young age of 40.

One will be amused to hear in the film's voiceover (in Maryam's own voice), that she was initially not interested in math! She enjoyed reading and writing novels and wanted to become a writer. Through middle school and high school though, she learned to think mathematically, succeed at many problems, and was chosen to study in a special school for talented girl students. Interestingly, the film explains how in Iran, promising students of both sexes are encouraged to pursue math. Studying in a girls-only school would have avoided the comparisons between boys and girls that feed into gender-biased behaviour and stereotypes. Indeed, the film makes clear that in Iran there was no stereotype that girls couldn't do math or that women were discouraged to pursue it at higher study. It says in the film that 50% of those students going into mathematics at higher levels, are girls!

Through the film, it is a compelling experience to watch and listen to many young Iranian women or now-grown classmates of Maryam's talk passionately about the subject and the inspiration Maryam had given them in their lives. Thus it is a film also about women in the field of mathematics and gives a glimpse of girls being educated in Tehran and Isfahan. Maryam weaves her way through awards, competitions, and even won the gold medal at the national level Olympiad. No girls had won this before her.

The film has frequent images of beautiful buildings, artistic walls, intricate carvings, courtyards and spaces from Iran; in a sense math is everywhere. You will be intrigued by the concepts and geometric theorems being proposed. Through the many voices carrying you in the film, you feel the excitement of those embedded in a discovery. The film does a good job of explaining something very complex in such a way that you feel you got a glimpse of its depth. Students of mathematics may balk at the idea of giving a hard problem more than an hour or so of their effort, but Maryam had to persevere for nearly two years at a beautiful and challenging problem, before the solution came to her! It was well worth the wait.

In her country, Maryam was a symbol of hope and inspiration to many young school-going children especially girls, and was even solicited for a political role! On large posters she was represented without a scarf because that was how she came to be known beyond her country. It is interesting that someone who excelled in a particular discipline was treated as a national hero in the general context as well. That such a person could come from the heart of a war-torn country will always be a source of national pride for Iran.

After her passing, people felt such a loss and sadness as if they had lost a good friend, a colleague and an incredibly inspiring person. Despite her genius and vision, her friends and family describe her as a modest, collaborative, warm person, and quiet about her achievements. They felt she had a whole lifetime of mathematical work that could have been accomplished if she

had lived on. However, some voices in the film do say that what she did contribute was already immense, and that there are gems in her papers that will yield mathematical problems for years to come. Maryam had an instinct for framing deep and profound mathematical questions that will long outlive her.

Secrets of the Surface is a memorable film and one that opens doors in our minds: mathematics is an exciting vocation, and girls *can* become mathematicians. After watching

the film, you can have a discussion in class around these points, including the question of whether one must be a genius to enjoy and fruitfully study higher math! On the contrary, at all levels, students of mathematics can partake of the kind of excitement that Maryam had, the way patterns fall into place and the beauty of numbers and shapes. In the end, maybe we could think of Maryam less as a ‘prodigy’ and more as a bright spark in the world of math, a spark that was encouraged to burst into a beautiful, light-giving flame.

1. Nora S Newcombe (2010). Picture This: Increasing Math and Science Learning by Improving Spatial Thinking. *American Educator*, Summer 2010 (29-43)
2. Kamala V Mukunda (2019). Ch 6: Untapped Potential. From *What Did You Ask at School Today? Book Two*: Harper Collins India.



The authors are both teachers at Centre For Learning. Keerthi teaches English and social science for middle and high school age groups, and is interested in curriculum development and classroom practices. Kamala teaches mathematics and psychology, and has written two books—*What Did You Ask at School Today* (Books One and Two: HarperCollins India)—summarizing psychological findings of relevance to educators and parents.